CLAIMS

1. A Si/C superlattice useful for semiconductor devices, comprising a plurality of epitaxially grown silicon layers alternating with carbon layers respectively adsorbed on surfaces of said silicon layers.

2. A Si/C superlattice according to claim 1, wherein said superlattice forms a structure in which each epitaxial silicon layer has been epitaxially grown on a surface of an underlying silicon layer, said surface of said underlying silicon layer having a carbon layer adsorbed thereon.

3. The Si/C superlattice according to claim 1, comprising from 2 to about 16 epitaxial silicon layers.

4. The Si/C superlattice according to claim 3, comprising 3 to 9 epitaxial silicon layers.

5. The Si/C superlattice according to claim 1, wherein the carbon layer adsorbed on the silicon layer surface is a carbon monolayer.

6. The Si/C superlattice according to claim 2, wherein the carbon layer adsorbed on the silicon layer surface is a carbon monolayer.

7. The Si/C superlattice according to claim 1, wherein each epitaxial silicon layer is an ultrathin layer.

8. The Si/C superlattice according to claim 7, wherein each epitaxial silicon layer is less than about 4 nm in thickness.

9. The Si/C superlattice according to claim 7, wherein each epitaxial silicon layer is less than about 2 nm in thickness.

10. The Si/C superlattice according to claim 1, further comprising a low defect density silicon substrate over which said alternating layers of silicon and carbon were grown.

11. The Si/C superlattice according to claim 10, wherein a surface of said substrate has an adsorbed layer of carbon over which a layer of silicon of said superlattice was epitaxially grown.

12. A structure useful for electronic or opto-electronic devices, said structure comprising a Si/C superlattice comprising a plurality of epitaxially grown silicon layers alternating with carbon layers respectively adsorbed on surfaces of said silicon layers, said superlattice having an upper end in the direction of epitaxial silicon layer growth and a

lower end in the opposite direction; a top layer comprising epitaxial silicon disposed at said upper end; and a low defect density silicon substrate disposed at said lower end.

13. The structure according to claim 12, wherein said superlattice forms a structure in which each epitaxial silicon layer has been epitaxially grown on a surface of an underlying silicon layer, said surface of said underlying silicon layer having a carbon layer adsorbed thereon.

14. The structure according to claim 12, wherein said superlattice comprises from 2 to about 16 epitaxial silicon layers.

15. The structure according to claim 12, wherein said superlattice comprises 3 to 9 epitaxial silicon layers.

16. The structure according to claim 12, wherein in said superlattice the carbon layer adsorbed on the silicon layer surface is a carbon monolayer.

17. The structure according to claim 12, wherein in said superlattice each epitaxial silicon layer is less than about 4 nm in thickness.

18. The structure according to claim 12, wherein in said superlattice each epitaxial silicon layer is less than about 2 nm in thickness.

19. The structure according to claim 12, wherein said silicon substrate comprises a silicon buffer layer disposed in contact with the lower end of said superlattice.

20. The structure according to claim 19, wherein said buffer layer has a thickness of from about 200 nm to about 300 nm.

21. The structure according to claim 12, wherein said epitaxial silicon top layer has a thickness from about 15 nm to about 75 nm.

22. The structure according to claim 12, wherein a layer of silicon oxide is disposed between said superlattice and said substrate.

23. A structure useful for electronic or opto-electronic devices, said structure comprising a Si/C superlattice comprising a plurality of epitaxially grown silicon layers alternating with carbon layers respectively adsorbed on surfaces of said silicon layers, said superlattice having an upper end in the direction of epitaxial silicon layer growth and a lower end in the opposite direction; a top layer comprising epitaxial silicon carbide disposed at said upper end; and a low defect density silicon substrate disposed at said lower end.

24. The structure according to claim 23, wherein said superlattice forms a structure in which each epitaxial silicon layer has been epitaxially grown on a surface of an underlying silicon layer, said surface of said underlying silicon layer having a carbon layer adsorbed thereon.

25. The structure according to claim 23, wherein said superlattice comprises from 2 to about 16 epitaxial silicon layers.

26. The structure according to claim 23, wherein said superlattice comprises 3 to 9 epitaxial silicon layers.

27. The structure according to claim 23, wherein in said superlattice the carbon layer adsorbed on the silicon layer surface is a carbon monolayer.

28. The structure according to claim 23, wherein in said superlattice each epitaxial silicon layer is less than about 4 nm in thickness.

29. The structure according to claim 23, wherein in said superlattice each epitaxial silicon layer is less than about 2 nm in thickness.

30. The structure according to claim 23, wherein said silicon substrate comprises a silicon buffer layer disposed in contact with the lower end of said superlattice.

31. The structure according to claim 30, wherein said buffer layer has a thickness of from about 200 nm to about 300 nm.

32. The structure according to claim 23, wherein a layer of silicon oxide is disposed between said superlattice and said substrate.

33. The structure according to claim 23, wherein one or more epitaxial silicon layers of said superlattice were converted to silicon carbide.

34. The structure according to claim 33, wherein a layer of silicon oxide is disposed between said superlattice and said substrate.

35. A structure useful for electronic or opto-electronic devices, said structure comprising a Si/C superlattice comprising a plurality of epitaxially grown silicon layers alternating with carbon layers respectively adsorbed on surfaces of said silicon layers, said superlattice having an upper end in the direction of epitaxial silicon layer growth and a lower end in the opposite direction; a top layer comprising polycrystalline silicon carbide disposed at said upper end; and a low defect density silicon substrate disposed at said lower end.

36. The structure according to claim 35, wherein said superlattice forms a structure in which each epitaxial silicon layer has been epitaxially grown on a surface of an underlying silicon layer, said surface of said underlying silicon layer having a carbon layer adsorbed thereon.

37. The structure according to claim 35, wherein said superlattice comprises from 2 to about 16 epitaxial silicon layers.

38. The structure according to claim 35, wherein said superlattice comprises 3 to 9 epitaxial silicon layers.

39. The structure according to claim 35, wherein in said superlattice the carbon layer adsorbed on the silicon layer surface is a carbon monolayer.

40. The structure according to claim 35, wherein in said superlattice each epitaxial silicon layer is less than about 4 nm in thickness.

41. The structure according to claim 35, wherein in said superlattice each epitaxial silicon layer is less than about 2 nm in thickness.

42. The structure according to claim 35, wherein a layer of silicon oxide is disposed between said superlattice and said substrate.

43. The structure according to claim 35, wherein one or more epitaxial silicon layers of said superlattice were converted to silicon carbide.

44. The structure according to claim 43, wherein a layer of silicon oxide is disposed between said superlattice and said substrate.

45. In a semiconductor device comprising an insulator or barrier material, the improvement comprising replacement of said insulator or barrier material with a superlattice comprising a plurality of epitaxially grown silicon layers alternating with carbon layers respectively adsorbed on surfaces of said silicon layers.

46. A system for producing low defect density silicon carbide, comprising:

a template consisting of a superlattice comprising a plurality of epitaxially grown silicon layers alternating with carbon layers respectively adsorbed on surfaces of said silicon layers;

MBE means for depositing epitaxial silicon carbide on said template;

CVD means for depositing silicon carbide on said epitaxial silicon carbide.

47. A method for manufacturing low defect density silicon carbide for use in semiconductor devices, comprising:

(a) providing a template consisting of a superlattice comprising a plurality of epitaxially grown silicon layers alternating with carbon layers respectively adsorbed on surfaces of said silicon layers;

(b) depositing epitaxial silicon carbide on said template by MBE; and

(c) depositing silicon carbide on said deposited epitaxial silicon carbide by CVD.

48. The method according to claim 47, wherein said template provided in step (a) is produced by MBE wherein each epitaxial silicon layer has been epitaxially grown on a surface of an underlying silicon layer, said surface of said underlying silicon layer having a carbon layer adsorbed thereon.

49. The method according to claim 47, wherein epitaxial silicon carbide is deposited in step (b) at temperature from about 700°C to about 1000°C.

50. The method according to claim 47, wherein silicon carbide is deposited in step (c) at temperature from about 1400°C to about 1800°C.

51. A structure useful for electronic or opto-electronic devices, said structure comprising a Si/C superlattice comprising a plurality of epitaxially grown silicon layers alternating with carbon layers respectively adsorbed on surfaces of said silicon layers, said superlattice having an upper end in the direction of epitaxial silicon layer growth and a lower end in the opposite direction; and a top layer comprising silicon carbide deposited by CVD disposed at said upper end.

52. The structure according to claim 51, wherein one or more epitaxial silicon layers of said superlattice were converted to silicon carbide.

53. The structure according to claim 51, further comprising a low defect density silicon substrate disposed at said lower end.

54. The structure according to claim 52, further comprising a low defect density silicon substrate disposed at said lower end.